CLAIMS

1. A variable focus lens comprising a transparent envelope at least partially defined by a flexible, transparent membrane and containing a transparent fluid, a frame member engaging one face of the flexible membrane and a ring member engaging an opposite face of the flexible membrane, the ring member and the frame member being urged towards each other by retaining means, wherein the respective surfaces of the frame member and the ring member that engage the flexible membrane are substantially complementary and profiled so as to cause a peripheral region of the flexible membrane to change direction more than once.

2. A variable focus lens as claimed in claim 1, wherein the profiles of the engaging surfaces are stepped.

3. A variable focus lens as claimed in claim 1, wherein the profiles of the engaging surfaces comprise one or more projections and complementary recess(es).

4. A variable focus lens as claimed in claim 1, wherein the ring member and frame member are. of a material or materials which is/are sufficiently rigid to positively interengage with each other and to ensure that the ring member and frame member can maintain the flexible membrane under tension.

5. A variable focus lens as claimed in claim 4, wherein the material of the ring member and frame member is also lightweight.

6. A variable focus lens as claimed in claim 5, wherein the ring member and frame member are made of a

high impact resistant plastics material.

7. A variable focus lens as claimed in claim 6, wherein the ring member and frame member are made of aluminium.

8. A variable focus lens as claimed in claim 6, wherein the ring member and frame member are made of titanium.

9. A variable focus lens as claimed in claim 1, wherein at least one of the surfaces is a high friction surface.

10. A variable focus lens comprising a transparent envelope at least partially defined by a flexible, transparent membrane and containing a transparent fluid, a frame member engaging one face of the flexible membrane and a ring member engaging an opposite face of the flexible membrane, the ring member and the frame member being urged towards each others by retaining means, wherein the respective surfaces of the frame member and the ring member that engage the flexible membrane are substantially complementary and at least one of the surfaces is a high friction surface.

11. A variable focus lens as claimed in claim 9, wherein one or more of the frame member and the ring member is made of a material having a high coefficient of friction at its surface.

12. A variable focus lens as claimed in claim 1, wherein the ring member and the frame member have a circular, oval, elliptical, or other closed curve, peripheral shape.

13. A variable focus lens as claimed in claim 1,

wherein the frame uieiuber comprises a rigid transparent window forming a wall of the envelope.

14. A variable focus lens as claimed in claim 13, wherein the rigid window is of a suitable material, such as glass or a plastics material such as polycarbonate.

15. A variable focus lens as claimed in claim 14, wherein the frame member is made entirely of such transparent material.

16. A variable focus lens as claimed in claim 13, wherein the rigid window forms a part of the frame member, for example being bonded to and/or enclosed by an annular frame.

17. A variable focus lens as claimed in claim 1, wherein the frame member is provided with a second engaging surface engaging a second membrane.

18. A variable focus lens as claimed in claim 17, wherein a second ring member is provided with a second engaging surface for engaging the second membrane.

19. A variable focus lens as claimed in claim 17, wherein the second engaging surface is opposed to the first engaging surface of the frame member.

20. A variable focus lens as claimed in claim 17, wherein the second membrane defines a wall of the envelope.

21. A variable focus lens as claimed in claim 1, wherein the first ring member is provided with a second engaging surface engaging a second membrane.

22. A variable focus lens as claimed in claim 21,

wherein a second ring member is provided with a second engagiuy surface for engaging the second membrane.

23. A variable focus lens as claimed in claim 20, wherein the second engaging surface is opposed to the first engaging surface of the first ring member.

24. A variable focus lens as claimed in claim 21, wherein the second membrane defines a wall of the envelope.

25. A variable focus lens as claimed in claim 17, wherein the first and second membranes are formed from a single membrane web.

26. A variable focus lens as claimed in claim 17, wherein the first and second membranes are discrete.

27. A variable focus lens as claimed in claim 1, wherein a duct is provided through a wall of the envelope, which duct is in communication with the envelope.

28. A variable focus lens as claimed in claim 27, wherein said wall is a radially outer wall.

29. A variable focus lens as claimed in claim 26, wherein said duct is formed by a pre-formed bore in one or more of the first or second ring members or the frame member.

30. A variable focus lens as claimed in claim 26, wherein said duct is drilled in one or more of the first or second ring members or the frame member.

31. A variable focus lens as claimed in claim 27, wherein the duct is provided with suitable closure means

to prevent leakdye of fluid from the envelope through the duct.

32. A variable focus lens as claimed in claim 31, wherein said closure means take the form of a rubber or elastomer bung penetrable by a needle of a syringe and capable of self-sealing on removal of the needle.

33. A variable focus lens as claimed in claim 31, wherein a valve is provided in the duct, arranged so that the duct is normally closed, but capable of being opened by, for example, the needle of a syringe.

34. A variable focus lens as claimed in claim 33, wherein said valve comprises a ball urged by a spring against an annular seat.

35. A variable focus lens as claimed in claim 27, wherein a plurality of ducts are provided in a wall of the envelope.

36. A variable focus lens comprising a transparent envelope at least partially defined by a flexible, transparent membrane and containing a transparent fluid, and a plurality of ducts provided in a wall of the envelope for introducing fluid into the envelope.

37. A variable focus lens as claimed in claim 35, wherein the plurality of ducts are provided with respective closure means.

38. A variable focus lens as claimed in claim 35, wherein the plurality of ducts are provided with a single closure means.

39. A variable focus lens as claimed in claim 35, wherein the ducts are proximately grouped.

40. A variable focus lens as claimed in claim 27, wherein a single duct having a large cross-section is provided.

41. A variable focus lens as claimed in claim 40, wherein the cross-sectional area of the duct is increased by forming the duct such that its width perpendicular to the axis of the lens is greater than its width parallel to the axis of the lens.

42. A variable focus lens as claimed in claim 18, wherein respective retaining means are provided for each of said first and second ring members.

43. A variable focus lens as claimed in claim 1, dependent thereon, wherein the retaining means take the form of a deformable portion of one of the frame member and the ring member, arranged to be deformed, for example crimped, over the other of the frame member and the ring member.

44. A variable focus- lens as claimed in claim 43, wherein the deformable portion is of metal, such as aluminium, stainless steel or titanium.

45. A variable focus lens as claimed in claim 1, wherein said transparent fluid retained within the envelope is silicone oil, such as 703 type silicone oil.

46. A variable focus lens as claimed in claim 1, wherein the fluid is communicated to the envelope by means of a suitable pump, for example a syringe.

47. A pump for a variable focus lens comprising a fluid chamber having an outlet port and a linearly movable member arranged to vary the effective volume of the

fluid chamber, wherein locating means are provided for locating the movable member in a plurality of discrete positions.

48. A pump as claimed in claim 47, wherein said locating means are in the form of two stops arranged to limit the movement of the movable member, for example a piston or plunger, to a range having end points defined by respective stops.

49. A pump as claimed in claim 48, wherein the stops are variable in their positions.

50. A pump as claimed in claim 49, wherein the stops are lockable in a selected position.

51. A pump as claimed in claim 47, wherein the locating means comprises a series of locators which may be engaged by a suitable mating member, in order that the movable member is adjustable step-wise.

52. A pump as claimed in claim 51, wherein said series of locators are in the form of the teeth of a rack or the like.

53. A pump for a variable focus lens comprising a fluid chamber having an outlet port and means for linearly varying the volume of the fluid chamber in response to a rotational movement of a control member.

54. A pump as claimed in claim 53, wherein said pump comprises a pinion coupled for rotation with a control knob and engaging a rack coupled for linear movement to a piston provided in the fluid chamber.

55. A pump as claimed in claim 53, wherein a piston received within the fluid chamber is provided on a

threaded shaft, the shaft engaging with a complementary threaded collar, such that the collar or the shaft may be rotated to cause the piston to move linearly within the fluid chamber.

56. A pump as claimed in claim 53, wherein the interior of the fluid chamber is threaded, and the periphery of the piston is provided with a complementary thread such that rotation of the piston causes linear movement thereof with in the fluid chamber.

57. A pump as claimed in claim 53, comprising a barrel member with a threaded exterior, a circumferential wall, and a fluid port defined in an end wall thereof, which barrel member is received within a cap member provided with a complementary interior thread and an end wall opposed to the end wall of the barrel member, said fluid chamber being defined by the volume enclosed by the connected barrel and cap members.

58. A pump as claimed in claim 57, wherein said cap member is provided with a piston mounted in fixed relation to its end face and received within the barrel member, such that the fluid chamber is defined between the end face of the barrel member and the piston, and relative rotation of the barrel member and cap member causes the piston to reduce the effective volume of the fluid chamber.

59. A pump as claimed in claim 53, wherein locating means for locating the movable member in a plurality of discrete positions.

60. A variable focus lens in combination with a pump as claimed in claim 47.

61. Eyewear in which two variable focus lenses as

claimed in claim 60 are provided in a spectacle frame.

62. Eyewear as claimed in claim 61, wherein a single pump is provided.

63. Eyewear as claimed in claim 61, wherein a respective pump is provided for each lens, so that each lens is independently variable.

64. Eyewear as claimed in claim 61, wherein the pumps are provided on the arms of the spectacle frames, for example at the ends of the arms, so that they are hidden by the ears in use.

65. Eyewear as claimed in claim 61, wherein channels are be provided in the spectacle frame, for example in the arms, for fluid communication between the lenses and the pump(s).

66. Eyewear as claimed in claim 61, wherein the pump(s) are arranged to be detachable from the spectacles after an initial setting operation of the focus of the lenses.

67. Eyewear as claimed in claim 66, wherein the pump(s) are permanently detachable.

68. Eyewear as claimed in claim 66, wherein the pump(s) are arranged to be detachable from the spectacles such that when the pump(s) is/are detached the fluid communication channels are automatically closed off.

69. Eyewear as claimed in claim 68, wherein said channels are automatically closed off by means of a valve.

70. Eyewear as claimed in claim 63, comprising a pair of spectacles with two pumps, one for each lens, each

pump being removably attached to an arm of the spectacles, wherein fluid communication between each pump and its respective lens is achieved by means of flexible tubing extending from the pump to the lens, the tubing being received in a channel in the frame of the spectacles for at least a part of its length, the tubing being closed and cut after a user has set the focus of the lens, and the pump and the attached portion of tubing then being detached and discarded.

71. Eyewear as claimed in claim 70, wherein a part of the tubing connecting the lens and the pump is received in a channel formed in the main frame of the spectacles.

72. Eyewear as claimed in claim 71, wherein said channel is in the side of the main frame facing the user.

73. Eyewear as claimed in claim 70, wherein the tubing is closed by being clamped closed.

74. Eyewear as claimed in claim 73, wherein said tubing is clamped closed by means of a screw urging the sides of the tubing together.

75. Eyewear as claimed in claim 74, wherein a screw is provided in a passage in the frame of the spectacles, perpendicular to and intersecting the channel in which the tubing is received, wherein a member is provided on the side of the channel opposite the screw extending across the channel in the form of a bridge, and wherein the screw may be screwed into the passage to compress the tubing against the member to close it.

76. Eyewear as claimed in claim 75, wherein the member is formed by a part of the hinge attaching the arm of the spectacles to the main frame.

77. Eyewear as claimed in claim 73, wherein the tubing is clamped closed by means of a button which, when depressed, compresses the tubing against a member to close it.

78. Eyewear as claimed in claim 77, wherein said button is arranged to latch when it is depressed, to ensure that the tubing remains closed.

79. Eyewear as claimed in claim 76, wherein said button is provided with means for retaining it in its original position, to prevent accidental operation.

80. Eyewear as claimed in claim 79, wherein said means take the form of a protuberance on the button, which fits into a corresponding recess in the frame.

81. Eyewear as claimed in claim 70, wherein means are provided in the spectacles to allow the tubing to be cut.

82. Eyewear as claimed in claim 81, wherein a button carrying a blade is provided, the blade severing the tubing when the button is depressed.

83. Eyewear as claimed in claim 82, wherein the button which closes the tubing and the button which cuts it are combined, so that the tubing can be closed and cut in a single movement.

84. A method of filling an envelope of a variable focus lens with transparent fluid, including tha steps of sucking out some of the air in the envelope, injecting a similar amount of fluid into the envelope, and repeating the cycle of air removal followed by fluid injection until the envelope is filled with fluid.

85. A method of filling an envelope of a variable focus lens with transparent fluid, in which a needle is used to inject fluid into the envelope through a duct, wherein the external diameter of the needle is smaller than the internal diameter of the duct, such that air in the envelope can escape as fluid is injected.

86. A method of filling an envelope of a variable focus lenss with transparent fluid, wherein the fluid used to, fill the envelope is degassed prior to filling.

87. A method of filling an envelope of a variable focus lens with transparent fluid, in which the fluid is heated prior to filling, to reduce its viscosity.

88. A variable focus lens as claimed in claim 1, wherein said lens is provided with at least one transparent, protective cover for the or each flexible membrane.

89. A variable focus lens as claimed in claim 88 wherein the cover is a rigid sheet of transparent material.

90. A variable focus lens as claimed in claim 89, wherein said material is glass or a plastics such as polycarbonate.

91. A variable focus lens as claimed claim 1, wherein the or each flexible membrane is formed from a heat-shrinkable plastics material.

92. A method of making a variable focus lens having a flexible, transparent membrane supported in a frame, wherein the membrane is heat treated while held in the frame to increase the tension in the membrane.

93. A method as claimed in claim 92 wherein the heat is provided by a source of hot air, such as a hair dryer, a hot air gun or a fan heater.

94. A method of making a variable focus lens having a flexible, transparent membrane supported in a frame, wherein the membrane is pre-tensioned, and the frame is mounted to the membrane while the membrane is pre-tensioned.

95. Eyewear incorporating a variable focus lens as claimed in claim 1, wherein said eyewear is in the form of sunglasses, swimming goggles, skiing goggles, squash glasses, sports eyewear in general, welding masks, welding goggles, laboratory goggles, and protective eyewear in general.

96. Eyewear as claimed in claim 95, wherein said lens is provided as an insert.

97. Eyewear as claimed in claim 95, wherein the variable focus lens is attached to the outside of the eyewear.

98. A variable focus lens comprising an envelope of transparent fluid defined between two membranes, at least one of which is flexible, wherein one or both of the membranes or the fluid is tinted.

99. A variable focus lens comprising an envelope of transparent fluid defined between two membranes, at least one of which is flexible, said flexible membrane being formed from metallized Mylar.